

This Page Is Inserted by IFW Operations  
and is not a part of the Official Record

## **BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning documents *will not* correct images,  
please do not report the images to the  
Image Problem Mailbox.**

## SEQUENCE LISTING

<110> NELSON, DAVID R.

<120> A LIVE, AVIRULENT STRAIN OF V. ANGUILLARUM THAT  
PROTECTS FISH AGAINST INFECTION BY VIRULENT V.  
ANGUILLARUM

<130> 5112

<140> 09/915,706

<141> 2001-07-26

<160> 4

<170> PatentIn Ver. 2.1

<210> 1

<211> 3588

<212> DNA

<213> *Vibrio anguillarum*

<220>

<221> modified\_base

<222> (3572)

<223> a, t, c, g, other or unknown

<400> 1

```

gtcgacttat tgcattgatg gcgtacatgg tagtgccatc cttcgtttgc taacaagcgt 60
tgtataaaaag cttggtcggg ttcacacagt tgaacacaat actcatgatt tttcccactt 120
ccggaaaaggg aaaagtgaag atagcttttg agatcagcct gttctagcag cttttcaatg 180
atctttttcg tcgttacgtt ttgaaaaatc tgacgactgc gtttgatttg caacaagcta 240
agtggatcca atatctctat ttgataataa aactgctgct tgtctttgct atatcctgtg 300
aattgcagag tgctacatat acctgaaaaa aaacgctttc cagaatctaa ttcgtaagac 360
acacaaaacag ctttacctag gtttttggtg tcgatctcca tgtttgccgc gatggaaaacg 420
gaaaaactgac acccgccgga tacgctttcc tctccgatta attgcgtgac aatataactt 480
ttgctatctg aaagcttaat ggtgagggag cgggtttggt gctttaattc gttactgctc 540
atattcaatt aattcactat taaataaaca gttctaaaag gctgtttatt ggatgaatat 600
tcgaaattat cacataataa ttgatgctat tattacttgc tgtattggtg tcaactttca 660
tgctctatac atgtaatatata tttcgagtta gaccttaatt caaggtaatt tgtctattta 720
attattatct gaataatatg taatcgattg ctttgtgggt atttttatgt ttgtttcatt 780
tttaatgacg gtgagcttgt gcattcatat tttttatgat gacaacatct ttgatgaagt 840
atttaagata ttgttaatgc atgagggggt tgcgtgtatt ttttatatta aatcataata 900
aatcaacaa tatatgttat tttgtgtctt tttatagtgt tcttttaaag aggtaggatg 960
acctaaagggt cgcctaaata tggcgtaa attgccattgct ataattcacc tcaaagatac 1020
actattggca aattgacaaa tatgtcactt cgtatgaaac aatattagta gatgttgttt 1080
ttgctgcaaa aataaaaatt tttctggttg aaataactca aggcctctag cgttttcctt 1140
tatcttaaaa tacaggaaat agcgattgaa gttaattgac acttaagcaa atagtcaacc 1200
taacagagca ggaacctatg ctttgtcaa agcatcaa attgagcaact tctaaacctc 1260
tgagtgatga ttcgatctgt ggcgtttatc ttaactgga aaaaagtgtt tttcgcccat 1320
tacgtaatga atttaatgtc gcgcaactg cgtgcgtaa gctaagtcaa aaccctagt 1380
ctgacgagag agatgcgtta caagaggcat gtctaaataa gtggaagatt ctctctgaca 1440
gtttgtacga acagttttca aaaacaacca gagatctga gctcatctca tggttgtgtg 1500
ctgctcaatt ccttctcgat accacattag aaagtgtgct gaatagcctt gagtgggttag 1560
cggatttaag tgagaagcac tgggatcacc tcaaccctgt actaccagt gaaacgctca 1620
aatctgatga tgataagggc aaagaaagag agcaagcaga tgcgaaaagt aaagcatttt 1680
tccaactagt cggcgatagc gaggaagct cgattctcta tgcgccggtg ctgcaactgc 1740
ccttagtcgg ggaagtgacg ttttttgact ttcaaagtgc agagagaaaa ggcgaaatca 1800

```

```

gccaaactgaa atctatgctt acgaccacgg tggcgcaaga gcgtttcgca attcaattca 1860
agatggaaaa cgccaaacgt tgtgtcacc aattagatcg tttgtcagcg ttggtgagca 1920
ctaagtgtca ttctctaggc agtcaaagta ccaacttcgg atttgcgaag tcaactgctta 1980
ccogtgttga aaacgctttg gttcatctaa gtggaattaa gttagcaccg aaagcggagg 2040
ccaagacagt agagcaagag gttgccgaaa gttcagtttc tgaaggggag ctgccaaagg 2100
atatggatac aaaacatata gagcgaatac cgatggcatc agagcaggct cagaccgtaa 2160
gccaacactt acacgcagga aacctctctg aactgggtaa tttaaacaat atgaaccgag 2220
acttagcttt ccatttgttg agagaagtct ctgattatct tccgagagc gaaccgcata 2280
gcccatttcc atttttgtta gaaaaagcga ttcgatgggg atatttatcc ttacctgagt 2340
tgctgcgaga aatgatgtcg gaacaaaacg gtgacgctct tagtacgatt tttaatgccg 2400
ccggaattgaa tcatctcgat caggttttgc tgccggagggt gactactcca acggtgggca 2460
ttgaaagccc ccaaacacct caagcgaagc cttccgtttc ggatccgcga agtggtgaag 2520
agcatgtatc tcagacttcc cctgtagata cccaatctaa gcaagatcaa aaaccacaat 2580
catccgctac gtcggctctg agttggtaat tgtgtttaa aaataaggaa aaatcatggc 2640
aagtatttac atgcgtgtaa gcggtcttca agttgagggc gcagcgacta tcggtcagct 2700
agaaacggct gaaggtaaaa atgacgggtg gtttgcaatc aactcttact cttgggggtg 2760
cgctcgtaac gttgctatgg acatcggtaa cggcaccaat gcggattcag gcatggttgg 2820
cgtaagcgaa gttagcgtaa ctaaagaagt cgtgggtgct tctgaagacc tactgtctta 2880
tttattcaac ccaggtaaa acggtaaaac tgttgaggtt gcatttacta agccttctaa 2940
cgatgggtcaa ggtgcagacg tttacttcca agttaagcta gaaaaagcac gtttagtttc 3000
ttacaacgtg agcgggactg acggatctca accgtacgag agcctatctc tttcttacac 3060
ttctatttct cagaagcatc actatgagaa agaaggtggt gaactacaaa gcggtgggtg 3120
tgtgacttac gacctaccga ccgggaaaat gacttctggt aagtaattct ttcattagac 3180
atgccacgtt aattggcatg tctatttcat gaatatctca ttttaggaca ccgttatggc 3240
attgaactca caacataagc gcgttagtaa gaaccgtgtc agcatcacct atgacgttga 3300
aacgaatggc gccgtaaaga cgaaagagct gccgtttggt gttggcgtca ttggcgactt 3360
ttcaggacac aaaccagaat cagaaaaagt tgatttagaa gagcgagagt tcacgggtat 3420
cgataaagac aacttcgata cagtgatggg gcaaatcac ccgcgtcttt cgtacaaggt 3480
tgataacaag cttgctaag atgatagcca gtttgaagt aacttgagcc tccgttcgat 3540
gaaagatttc caccagaga acttagttga tnaaattgag ccgcttaa 3588

```

<210> 2

<211> 463

<212> PRT

<213> *Vibrio anguillarum*

<400> 2

```

Met Pro Leu Ser Lys His Gln Ile Glu Gln Leu Ser Lys Pro Leu Ser
 1              5              10              15

Asp Asp Ser Ile Cys Gly Val Tyr Leu Lys Leu Glu Lys Ser Ala Phe
      20              25              30

Arg Pro Leu Arg Asn Glu Phe Asn Val Ala Gln Thr Ala Leu Arg Lys
      35              40              45

Leu Ser Gln Asn Pro Ser Ala Asp Glu Arg Asp Ala Leu Gln Glu Ala
      50              55              60

Cys Leu Asn Lys Trp Lys Ile Leu Ser Asp Ser Leu Tyr Glu Gln Phe
      65              70              75              80

Ser Lys Thr Thr Arg Asp Ile Glu Leu Ile Ser Trp Phe Val Ala Ala
      85              90              95

Gln Phe Leu Leu Asp Thr Thr Leu Glu Ser Ala Ala Asn Ser Leu Glu
      100              105              110

```

Trp Leu Ala Asp Leu Ser Glu Lys His Trp Asp His Leu Asn Pro Val  
 115 120 125  
 Leu Pro Val Glu Thr Leu Lys Ser Asp Asp Asp Lys Gly Lys Glu Arg  
 130 135 140  
 Glu Gln Ala Asp Ala Lys Val Lys Ala Phe Phe Gln Leu Val Gly Asp  
 145 150 155 160  
 Ser Glu Glu Ser Ser Ile Leu Tyr Ala Pro Val Leu Gln Leu Pro Leu  
 165 170 175  
 Val Gly Glu Val Thr Phe Phe Asp Phe Gln Ser Ala Glu Arg Lys Gly  
 180 185 190  
 Glu Ile Ser Gln Leu Lys Ser Met Leu Thr Thr Thr Val Ala Gln Glu  
 195 200 205  
 Arg Phe Ala Ile Gln Phe Lys Met Glu Asn Ala Lys Arg Cys Val Thr  
 210 215 220  
 Gln Leu Asp Arg Leu Ser Ala Leu Val Ser Thr Lys Cys His Ser Leu  
 225 230 235 240  
 Gly Ser Gln Ser Thr Asn Phe Gly Phe Ala Lys Ser Leu Leu Thr Arg  
 245 250 255  
 Val Glu Asn Ala Leu Val His Leu Ser Gly Ile Lys Leu Ala Pro Lys  
 260 265 270  
 Ala Glu Ala Lys Thr Val Glu Gln Glu Val Ala Glu Ser Ser Val Ser  
 275 280 285  
 Glu Gly Glu Leu Pro Ser His Met Asp Thr Lys His Ile Glu Arg Ile  
 290 295 300  
 Pro Met Ala Ser Glu Gln Ala Gln Thr Val Ser Gln His Leu His Ala  
 305 310 315 320  
 Gly Asn Leu Ser Glu Leu Gly Asn Leu Asn Asn Met Asn Arg Asp Leu  
 325 330 335  
 Ala Phe His Leu Leu Arg Glu Val Ser Asp Tyr Phe Arg Gln Ser Glu  
 340 345 350  
 Pro His Ser Pro Ile Ser Phe Leu Leu Glu Lys Ala Ile Arg Trp Gly  
 355 360 365  
 Tyr Leu Ser Leu Pro Glu Leu Leu Arg Glu Met Met Ser Glu Gln Asn  
 370 375 380  
 Gly Asp Ala Leu Ser Thr Ile Phe Asn Ala Ala Gly Leu Asn His Leu  
 385 390 395 400  
 Asp Gln Val Leu Leu Pro Glu Val Ser Thr Pro Thr Val Gly Ile Glu  
 405 410 415

Ser Pro Gln Thr Pro Gln Ala Lys Pro Ser Val Ser Asp Pro Arg Ser  
                   420                  425                  430

Val Glu Glu His Val Ser Gln Thr Ser Pro Val Asp Thr Gln Ser Lys  
                   435                  440                  445

Gln Asp Gln Lys Pro Gln Ser Ser Ala Thr Ser Ala Leu Ser Trp  
                   450                  455                  460

<210> 3

<211> 176

<212> PRT

<213> *Vibrio anguillarum*

<400> 3

Met Ala Ser Ile Tyr Met Arg Val Ser Gly Leu Gln Val Glu Gly Ala  
                   1                  5                  10                  15

Ala Thr Ile Gly Gln Leu Glu Thr Ala Glu Gly Lys Asn Asp Gly Trp  
                   20                  25                  30

Phe Ala Ile Asn Ser Tyr Ser Trp Gly Gly Ala Arg Asn Val Ala Met  
                   35                  40                  45

Asp Ile Gly Asn Gly Thr Asn Ala Asp Ser Gly Met Val Gly Val Ser  
                   50                  55                  60

Glu Val Ser Val Thr Lys Glu Val Asp Gly Ala Ser Glu Asp Leu Leu  
                   65                  70                  75                  80

Ser Tyr Leu Phe Asn Pro Gly Lys Asp Gly Lys Thr Val Glu Val Ala  
                   85                  90                  95

Phe Thr Lys Pro Ser Asn Asp Gly Gln Gly Ala Asp Val Tyr Phe Gln  
                   100                  105                  110

Val Lys Leu Glu Lys Ala Arg Leu Val Ser Tyr Asn Val Ser Gly Thr  
                   115                  120                  125

Asp Gly Ser Gln Pro Tyr Glu Ser Leu Ser Leu Ser Tyr Thr Ser Ile  
                   130                  135                  140

Ser Gln Lys His His Tyr Glu Lys Glu Gly Gly Glu Leu Gln Ser Gly  
                   145                  150                  155                  160

Gly Val Val Thr Tyr Asp Leu Pro Thr Gly Lys Met Thr Ser Gly Lys  
                   165                  170                  175

<210> 4

<211> 117

<212> PRT

<213> *Vibrio anguillarum*

<220>

<221> MOD\_RES

<222> (113)

<223> Variable amino acid

```

<400> 4
Met Ala Leu Asn Ser Gln His Lys Arg Val Ser Lys Asn Arg Val Ser
  1                               5                10                15

Ile Thr Tyr Asp Val Glu Thr Asn Gly Ala Val Lys Thr Lys Glu Leu
      20                25                30

Pro Phe Val Val Gly Val Ile Gly Asp Phe Ser Gly His Lys Pro Glu
      35                40                45

Ser Glu Lys Val Asp Leu Glu Glu Arg Glu Phe Thr Gly Ile Asp Lys
      50                55                60

Asp Asn Phe Asp Thr Val Met Gly Gln Ile His Pro Arg Leu Ser Tyr
      65                70                75                80

Lys Val Asp Asn Lys Leu Ala Asn Asp Asp Ser Gln Phe Glu Val Asn
      85                90                95

Leu Ser Leu Arg Ser Met Lys Asp Phe His Pro Glu Asn Leu Val Asp
      100                105                110

Xaa Ile Glu Pro Leu
      115

```